Cognitive studies in children with mild mental retardation with externalizing behavioural disorders

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CHAPTER 2

ATTENTIONAL STUDIES IN CHILDREN WITH MILD MENTAL RETARDATION AND EXTERNALIZING PROBLEMATIC BEHAVIOUR (CD AND ADHD)[1]

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The aim of the study was to investigate a number of attentional abilities in children with mild mental retardation and an externalizing disorder. For this purpose, a visual scanning test, a visuo-spatial detection test and a dual-task paradigm were used. Findings indicated that attentional functions of children with external disorders and mild mental retardation are intact. These children even outperformed the normal control group within some attentional parameters.

Keywords: Mild Mental Retardation, Externalizing Disorders (ADHD, CD), Visual Scanning, Covert Attentional Shifting, Divided Attention.

[1] SUBMITTED FOR PUBLICATION

INTRODUCTION EXPERIMENT 1

Visual scanning is a form of selective attention and may be defined as the ability to suppress the processing of irrelevant information while simultaneously selecting relevant information. To evaluate visual scanning in children with Mild Mental Retardation (MMR) and externalizing disorders [Conduct Disorder (CD)/Attention-Deficit/Hyperactivity Disorder (ADHD)] a test is used in which subjects are instructed to scan a matrix for a critical target and to ignore non-critical but similar targets. The test is used as a screening instrument in clinical settings in which a poor score may be associated with impaired eye-movements, an impaired scanning system, problems with monitoring or directing attention, or problems with sustained attention. If a subject performs poorly in this test, then additional testing is recommended in order to determine the type of deficit in more detail (Zimmermann & Fimm, 1997). As well as being used as a (broadband) screening instrument, the test has been used in a developmental study showing that visual scanning improves with age (Kunert, Derichs & Irle 1996).

The aim of Experiment 1 was to explore visual scanning in MMR children with externalizing disorders using the visual scanning test. It was expected that compared to a normal control group, the MMR group with externalizing disorders would perform poorly (longer latencies, and the detection of fewer targets).

METHOD

Participants

Thirty children (24 of which were boys) with a mean IQ of 74 (SD = 8) [IQ was assessed using the WISC-RN (comprehensive version)] and a mean age of 146 months (SD = 16) participated in the study. The parents or custodians had to give written consent for the participation of the children (informed consent). The children themselves participated on a strictly voluntary basis. Children met DSM-III-R criteria for ADHD and CD and the IQ alone is only pertinent as far as Borderline Intellectual Functioning is concerned. However as this sample of children has many comorbid problems, mild mental retardation is a more appropriate description according to DSM.

A qualified child psychiatrist and a qualified child psychologist made independent diagnoses. Only when the two diagnoses agreed, was each child selected for the experiments. The CBCL-TRF was also applied and no aetiologies of MMR were identified. Children were also free from manifest psychiatric behaviour (i.e. psychotic) or neurological impairments. They were inpatients of the Van Arkel Institute, which is a residential establishment in central Holland. Criteria for residential placement were: the presence of both a dysfunctional family and disruptive behaviour in the community, which would preclude foster-care placement. Prior to their admission the subjects had also failed to respond to a course of outpatient psychotherapy.

About half of the children in the target group were on medication. For practical (with regard to the lengthy half-lives of medication) and ethical (possible deterioration of behaviour) reasons it was decided not to discontinue medication. In most cases this was a low dosage of Dipiperon ® (generic name: pipamperon). This is not common practice for the treatment of ADHD. Pipamperon is registered as an antipsychotic drug. In a normal dosage, pipamperon has a mild antipsychotic effect, a strong antiserotonine effect and is a mild sedative (Farmaco-therapeutisch kompas, 1996). It is also prescribed in clinical practice for aggressive behaviour in children and is administered when all other medication has been ineffective. The exact working mechanisms of the drug are unknown.

A low dosage of pipamperon has no side effects, it does not sedate and has no extrapiramidal effects (motor impairments for example), but it can claim to have a positive effect on the behaviour (less aggressive behaviour) of mentally retarded subjects (Van Putten, 1990). Also in low doses, pipamperon is a moderate dopamine-D2-antagonist and a strong serotonine-S2-antagonist (Van Putten, 1990). In every experiment, the effects of the medication will be evaluated in order to determine whether it had an effect on the task variables.

Figure 1 presents the CBLC-TRF scores of the MMR group with externalizing disorders. Note: It was not possible to assess the parents using the CBLC for two reasons: 1) not all the parents were able to co-operate, 2) several MMR children with externalizing disorders were placed in the institute under the Child Protection Act.

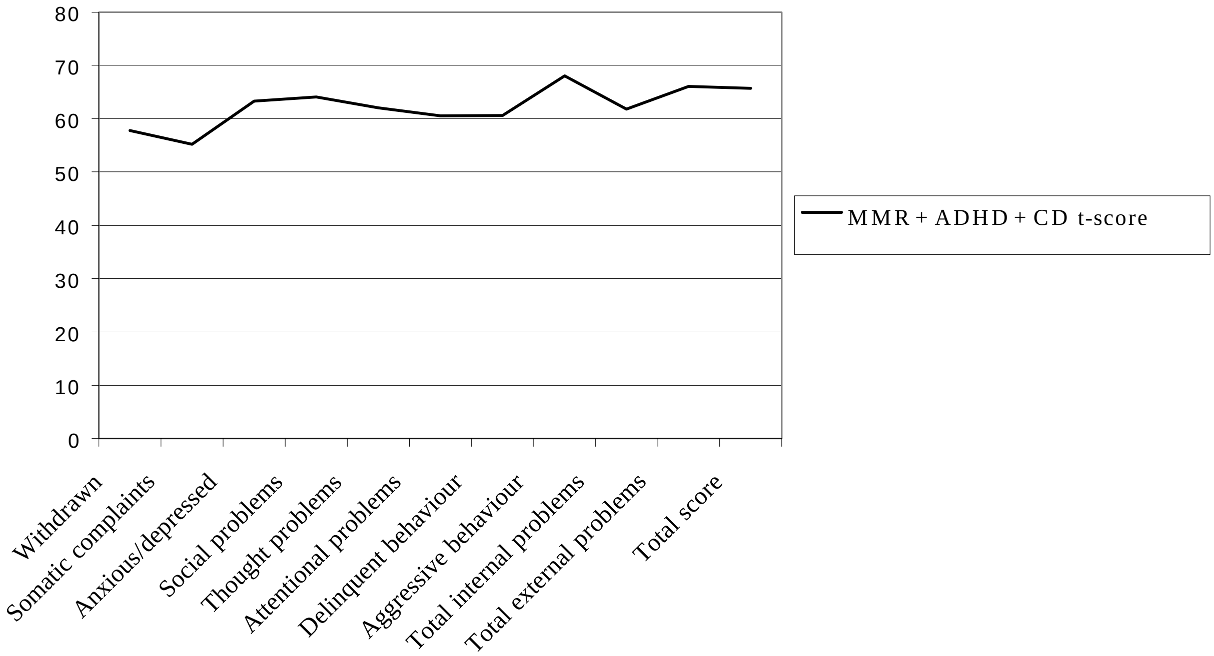

FIGURE 1. T-scores in the CBCL-TRF of the MMR children with externalizing disorders. Note: a score above 68 should be interpreted as significant problematic behaviour. A score of 50 (or lower) should be interpreted as free from behavioural problems.

The normal control group consisted of 188 children (98 of which were boys) with a mean IQ of 102 (SD = 11) and a mean age of 140 months (SD = 10). IQ was assessed using the WISC-RN (comprehensive version). These normal children were recruited from normal schools; therefore the control group can be best described as a random school population. The parents of the children were informed about the aim of the study in writing and by means of information sessions, and had to give written consent for the participation of their children. The children themselves participated on a voluntary basis and received no reward for their participation.

Test

The test is a subtest of the Test for Attentional Performance (Zimmermann & Fimm, 1996). The subject is instructed to search for a square (1.5 cm) in a matrix of 25 squares, 5 x 5, measuring about 12 x 12 cm presented on a computer screen. All squares are open on one side (an opening). See figure 2.

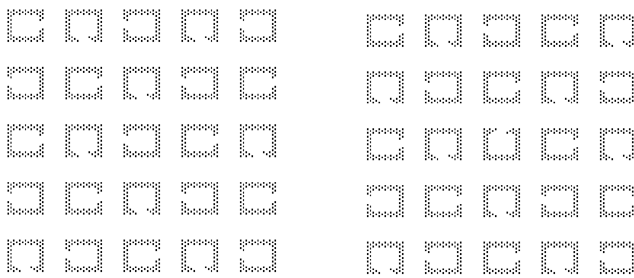

FIGURE 2. Examples of stimuli in the visual scanning test.

The matrix on the left of the figure shows a trial in which no critical square (an opening on the upper side of the square) is presented. In this case, the subject has to press the "no" button. The matrix on the right of the figure shows a trial in which a critical square is presented (an opening on the upper side of the square, in the example the central square). In this case, the subject has to press the "yes" response button. The critical square is presented in 50 % of a total of 100 trials. The critical stimulus was randomly distributed across the matrix. The localization is equally distributed among the successive rows (1 to 5). The test was self-pacing: matrixes were displayed directly after the child had pressed the button. The test lasted about 15 minutes.

Instruction and administration

The children were instructed to react as quickly as possible but to maintain a high level of accuracy. They practised the test for 3 minutes until they fully understood the intention of the test (criterion training). The test took place in a quiet room. During the entire experiment the researcher sat beside the child. No interaction between the researcher and the child was allowed during the experiment.

Design and analysis

The design was a repeated-measurement design with group (two levels: mild mentally retarded versus normal children) as the between-subject-factor. The number of the row (1 to 5) was the within-subject-factor. The dependent variables were the mean reaction times, the standard deviations of the reaction times, and the number of correct responses per row. Errors (pressing the "yes" button when no critical target was present) were left out of the analysis because very few were made. Analysis was done using: General Linear Model-Repeated Measures Model: Full-Factorial, sum of squares: Type III, contrasts: none.

RESULTS EXPERIMENT 1

Figure 3 presents the mean reaction times of the successive rows in the visual scanning test.

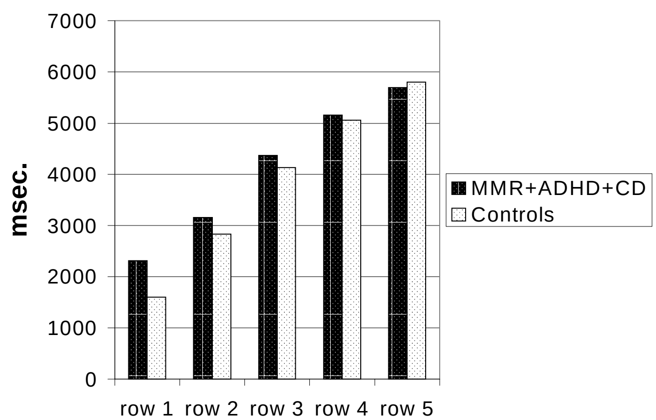

FIGURE 3. Mean reaction times in the visual scanning task.

Reaction times increased with each successive row of squares: this is confirmed by a significant row-number factor main effect ($F(4,840) = 191.209$; $p < .000$). The presence of such main effect is particularly suggestive in a scanning strategy, i.e. the groups scanned the rows as if they were reading although they were not explicitly instructed to do this. One of the main questions posed in the current study was whether the groups differed in their reaction times, i.e. did the MMR children have longer latencies than the control children. This was not the case: the main group effect regarding RT was ($F(1,210) = .807$; $p < .370$). Nor did groups differ in their mean RTs with respect to test-duration: the interaction of group vs. row number did not reach significance ($F(4,840) = 1,856$; $p < .116$). Figure 4 presents the standard deviations in the successive rows of squares in the visual scanning task.

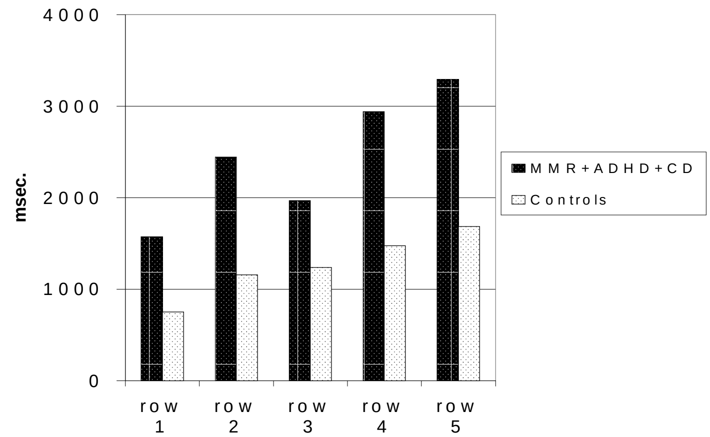

FIGURE 4. Standard deviations in the visual scanning task.

The variability of response increased as each successive row was scanned: this was expressed in a main effect of row-number ($F(4,828) = 21.969$; $p < .000$). The MMR group with externalizing disorders had a greater variability in response. This main effect of group was significant ($F(1,207) = 40.023$; $p < .000$). Figure 5 presents the number of correct responses (max. 10) in the visual scanning task.

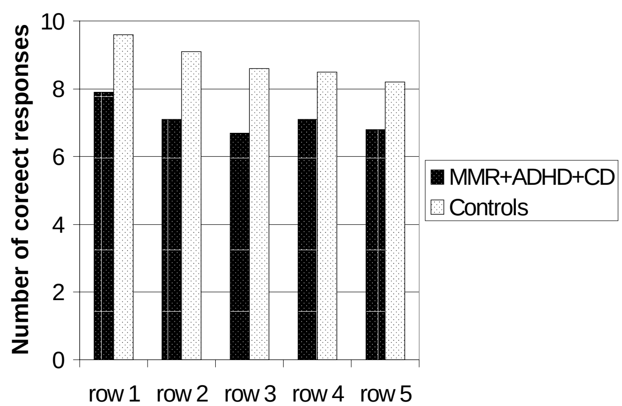

FIGURE 5. Number of correct responses in the visual scanning task (max. 10).

The MMR group with externalizing disorders detected significantly fewer critical stimuli than the control group: this group main effect was ($F(1,215) = 54.072$; $p < .000$). Groups did not differ in the time-on-task effect: both groups detected less critical stimuli with each successive row-number. The time-on-task effect was ($F(4,860) = 13.576$; $p < .000$), and the interaction group vs. row-number was ($F(4,860) = 1,048$; $p < ,381$).

INTRODUCTION EXPERIMENT 2

Posner (1980) designed a test to demonstrate that a number of attentional systems interact and collaborate. The test taps covert attentional processes such as engagement and disengagement.

Although various versions have been used since then, the main principle of the test remains one of stimulating (cueing) the subjects to push a button following target onset.
Figure 6 presents an example of a Posner task.

•
Fixation point

→
Cue

X
Target

Example of a valid cue condition

•
Fixation point

←
Cue

X
Target

Example of an invalid condition

FIGURE 6. Example of a valid and an invalid cue condition in the Posner task.

First, the subject has to focus on the dot on the screen. Then, a visual cue (an arrow) preceding the target informs the subject about the location of the target. Finally, the target (X) is presented. Cues may be valid (e.g. an arrow pointing to the right precedes a target on the right), or invalid (e.g. an arrow pointing to the left precedes a target on the right).

It is thought that the following set of mental functions take place (in an invalid cue condition) when a cue indicates where to focus one's attention in the visual field.

Alert
↓
Interrupt
↓
Localise
↓
Disengage
↓
Move
↓
Engage
↓
Inhibit

When attention is focused on a particular location such as the cued point, the visual processing of targets at that location is enhanced: the subject responds to targets more quickly. Concentrating on a location gives increased emphasis to targets at that location, this is called the Engage process.

Although subjects process a target quickly at the cued location, concentrating on that location causes them to respond more slowly to events happening elsewhere in the visual field; as is the case with the invalid cue condition. It takes time to disengage from the cued location, and this operation produces slower performance times at uncued locations of the target. Thus, performance is enhanced at the cued location and inhibited at other (uncued) locations. However, when the subject's attention has been drawn to a particular area of the visual field and a new area is then inspected or detected (the Disengage process, followed by the Move process and then finally the Engage process), it is less likely that the subject's attention will return to the previously cued location but rather that it will be drawn to other locations in the visual field. This inhibition of return helps to stimulate the movement of attention to new locations.

The test has been successfully applied in the clinical setting, showing that various patient groups, such as those including patients who have been treated for phenylketonuria since infancy (Craft, Gourovitch, Dowton, Swanson, & Bonforte, 1992), have difficulty disengaging attention after an invalid cue. A study by Jonkman, Licht, Bakker, and Van den Broek-Sandmann (1992) investigated the electrophysiological correlates of the ability to shift attention in dyslectic children and showed that early Evoked Potentials to the imperative stimulus were different in such children relative to the control group. The test has also been used in the field of developmental psychology (Akhtar & Enns, 1989; Enns & Brodeur, 1989). Here the costs and benefits of valid and invalid cues were assessed on the RTs of children and adults under conditions in which peripheral stimulus cues were used with a delay between cues and target onset of 150 ms. There were age-related differences in costs and benefits in RT. Under invalid cue conditions, the RTs of 6-year-old subjects were slower than those of 8 year old subjects, whose RTs were in turn slower than those of 20-year-old subjects. The inverse relationship between age and RT under the invalid cue condition was believed to reflect developmental changes in the ability to disengage attention from invalid cues. Under conditions in which valid cues were presented, 20-year-old subjects responded faster compared to invalid conditions, while similar benefits in RTs in children were not observed. Enns and Brodeur interpreted these findings as suggesting that the predictability of cue and target locations led to the development of an orienting strategy in adults that affected their covert attention; children failed to do this.

In sum, the test has shown to be powerful enough to detect cognitive deficits in clinical populations, and is sensitive enough to measure developmental change in mental functioning. For the purposes of the present study, the spatial cueing test was used to evaluate whether MMR children with externalizing disorders (ADHD and CD) have an attention deficit. If this was so, then the MMR group should have exhibited poorer performance levels than the control group, especially during the invalid cue condition (long RT s and more errors) which taps the capacity to disengage attention.

METHOD

Participants

The participants were the same as in the first experiment.

Test

The Posner test is a subtest of the Test for Attentional Performance (Zimmermann & Fimm 1996). The subject was instructed to focus on a dot presented in the middle of a monitor screen. The researcher checked whether the subject focused on the dot and a trial continued only when this was indeed the case. An arrow was then presented in the middle of the screen. In 50 % of the trials (n = 100) the arrow pointed to the right and in the other 50 % to the left. Finally, a target (X) was presented on the right or the left side of the screen and the subject was instructed to press a response button as fast as possible. In 80 % (n = 80) of the trials, the arrow pointed in the direction of the subsequent target location (the valid cue condition). In the other 20 % (n = 20), the arrow pointed in the opposite direction away from the subsequent target location (the invalid cue condition). Half of the targets were presented in the Right Visual Field and half in the Left Visual Field. In most of the Posner tests seen in literature there is a neutral condition. In this version of the Posner test the neutral condition is absent. The absence of a neutral condition has no influence on the test results (personal communication with the author of the test; the publication of this finding is in preparation). The interval between the presentation of the arrow (cue) and the target varied from 130 to 580 ms.. The experiment included instruction and training, which lasted about 15 minutes. Cue conditions were counterbalanced.

Instruction and administration

The children were instructed about the meaning of the test and were told to react as quickly as possible but to maintain a high level of accuracy. They practised the test for 3 minutes until they fully understood the intention of the test (criterion training). During the entire experiment the researcher sat beside the child positioned in such a manner that he could check the eye movements of the child. The test took place in a quiet room.

Design and analysis

The design was a repeated-measurement design with group (two levels: mild mentally retarded versus normal children) as the between-subjects-factor. The valid and invalid cue condition was the within-subject-factor. The mean of the reaction times, the standard deviation of the reaction times and the number of errors were the dependent variables. Anticipation errors and commission errors were excluded from the analysis because very few were made (about one in a total of a hundred trials). Analysis was done using a General Linear Model-Repeated Measures Model: Full-Factorial, sum of squares: Type III, contrasts: none.

RESULTS EXPERIMENT 2

Figure 7 presents the mean RT of the MMR group with externalizing disorders and the normal control group under valid and invalid cue conditions.

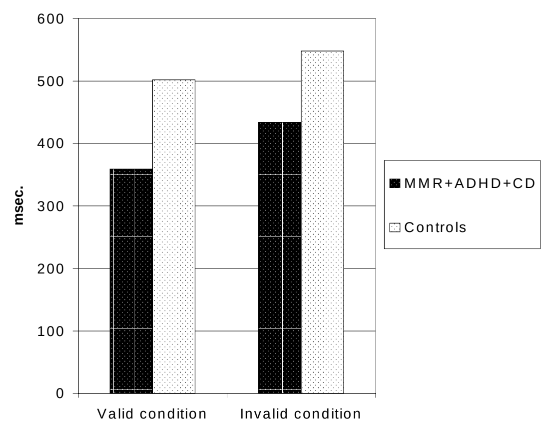

FIGURE 7. Reaction times in the Posner task.

Reaction time was faster under the valid cue condition relative to the invalid cue condition: the condition main effect was (F (1,215) = 1806.084; $p < .000$). Overall, the MMR group with externalizing disorders responded faster than the control group: the group main effect was (F (1,215) = 36.552; $p < .000$). The figure shows that the MMR children gained the most benefit from the valid cue information: i.e. their responses were faster in the valid cue condition relative to the invalid cue condition. This finding was statistically confirmed by an interaction group by condition (F (1,215) = 33.659; $p < .000$). Figure 8 presents the standard deviation in the Posner task.

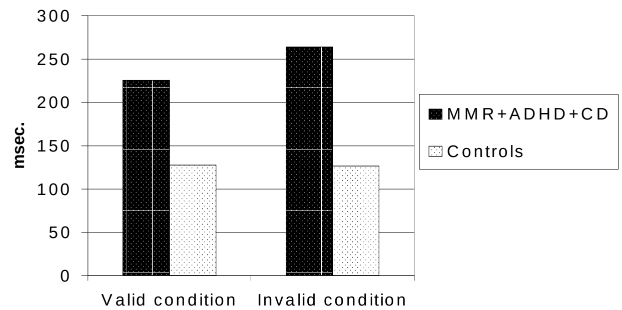

FIGURE 8. Standard deviations in the Posner task.

Overall, the MMR group with externalizing disorders had a significantly greater standard deviation of response than the control group: the group main effect for SD of RT was ($F(1,215) = 17.076$; $p < .000$). No significant effect from response condition was found for the standard deviation: the condition main effect was ($F(1,215) = 2.046$; $p < .154$).The two-way interaction group by condition was ($F(1,215) = 2.295$; $p < .131$). Figure 9 presents the number of errors in the Posner task.

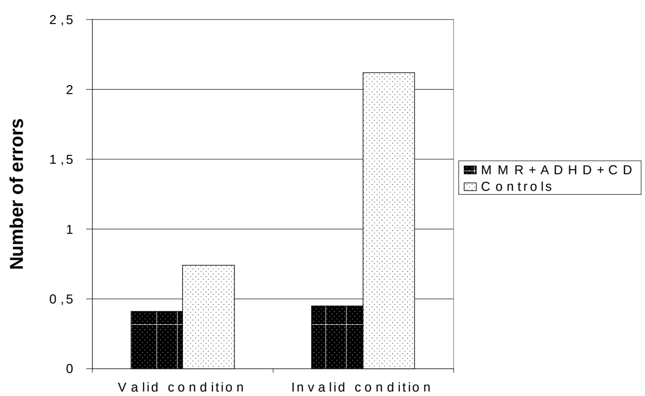

FIGURE 9. Number of errors in the Posner task.

Fewer errors were made under the valid cue condition than under the invalid cue condition: the condition main effect was ($F(1,215) = 85.865$; $p < .000$). The MMR group with externalizing disorders made fewer errors overall compared to the control group: the group main effect was ($F(1,215) = 22.478$; $p < .000$). In addition, the condition effect on errors was most pronounced in the control group: the two-way interaction between groups and condition was ($F(1,215) = 5.083$; $p < .025$).

A final analysis was carried out in order to determine whether there was an age effect with respect to the standard deviation of RT. For this purpose, groups were split in two, in such a manner that the MMR group with externalizing disorders had equal numbers of children from each age group; 14 younger children (mean age in months 133; 13 of which were boys; mean IQ = 76) and 15 older children (mean age in months 158; 10 of which were boys; mean IQ = 73) The control group consisted of 141 younger children (mean age in months 135; 68 of which were boys; mean IQ = 102), and 47 older children (mean age in months 155; 30 of which were boys; mean IQ = 100). The standard deviations of RT in the younger and older groups are presented in figure 10.

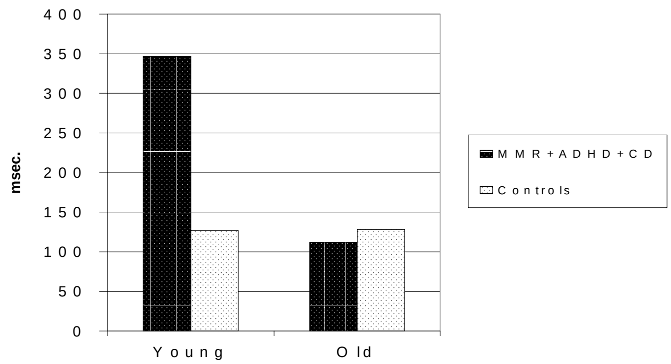

FIGURE 10. Standard deviations of younger and older children.

The main effect of age group was ($F(3,215) = 11.471$; $p < .000$). Post hoc analysis showed that only the younger MMR group with externalizing disorders differed significantly (on .000 level) from the other groups. All other differences were not significant. Therefore the younger children in the MMR group with externalizing disorders were the cause of the previously mentioned group main effect (MMR vs. Control) for standard deviation.

INTRODUCTION EXPERIMENT 3

The dual-task paradigm is designed to measure attention capacity in subjects. According to this paradigm, attention limitations arise when two mental tests have to be performed simultaneously (Posner & Peterson, 1990). In our dual task, the children had to first perform an auditory test and a visual test separately (baseline condition). Then, they had to execute the two tests simultaneously. This meant that their attention resources had to be divided over the two tests. According to the paradigm, test performance would be poorer in those with limited-attention capacity. The dual-task condition has been successfully applied in developmental studies. For example, Kunert, Derichs and Irle (1996) reported that the ability to divide attention improves with age. In addition, Kaye & Ruskin (1990) reported similar findings using a slightly different dual-task paradigm. We will also use the dual-task paradigm for the purposes of our study in order to test whether MMR children with externalizing behavioural disorders (ADHD + CD) have a limited divided-attention capacity.

METHOD

Participants

The children were virtually the same as in the former experiments, except that 5 MMR children were unable to attend because of holidays and referrals of the institute. Therefore only 25 MMR children with externalizing disorders (21 of which were boys) with a mean IQ of 75 (SD = 9) participated in the study. IQ was assessed using the WISC-RN test (comprehensive version). The group had a mean age of 144 months (SD = 14). The control group was exactly the same as in Experiments 1 and 2.

Test

The Divided Attention test is a subtest of the Test for Attentional Performance (Zimmermann & Fimm, 1996) and consists of three parts: the visual test, the auditory test and a combination of both tests. The test was implemented on an IBM PS/VP.

The visual test

Two types of matrices were presented: when the crosses formed a square, the subject had to press the response button; when no square was formed by the crosses, a "no" response was required. The critical / non-critical trials ratio was 20 : 80. The test lasted three minutes.

The auditory test

Here, the subjects were instructed to respond to irregularities in acoustic signals. The signals were either a high or a low tone (440 and 1000 Hz., 60 dB). The subjects were instructed to press a response button when two low or two high tones were presented in succession. The interval between the stimuli was fixed (1000 ms) and there were 16 critical stimuli in every 200.

The divided-attention condition

Here, the visual and auditory tests, which had previously been executed separately by the child (baseline conditions) were executed simultaneously (the divided-attention condition).

Instruction and administration

The children were instructed to react as quickly as possible but to maintain a high level of accuracy. Before each condition the children practised until they completely understood the intention of the test (criterion training). The practice session lasted about 2 minutes. After each condition a short break was taken. The test took place in a quiet room. During the experiment the researcher sat beside the child. No interaction between the researcher and the child was allowed during the experiment.

Design and analysis

The design was a repeated-measurement design with group (MMR versus control children) as the between-group-factor. Condition: 4 levels: 1) visual baseline condition with squares, 2) auditory baseline condition with acoustic signals, 3) divided-attention condition reaction to squares, 4) divided-attention condition reaction to acoustic signals was the within-subject-factor. The dependent variable was the percentage of correct responses.

RESULTS EXPERIMENT 3

Figure 11 presents the percentage of correct responses in the auditory and visual tests under baseline and divided-attention (dual-task) conditions.

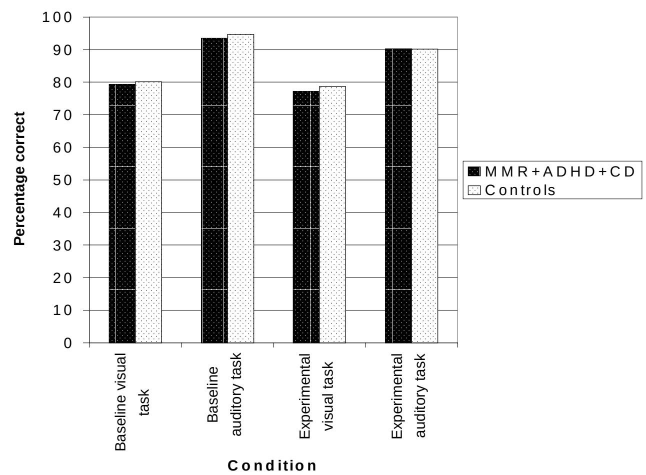

FIGURE 11. Percentage of correct responses in the divided-attention task.

Both groups were able to maintain a high level of performance efficiency under the divided-attention condition compared to the baseline condition: the group by condition interaction was ($F(1,210) = .42$, $p = .837$ for the visual test; the group by condition interaction for the auditory test was ($F(1,210) = .292$, $p = .590$.

As stated earlier, half of the MMR population was on medication during testing. Three analyses were carried out in order to determine whether medication was a confounding factor in the three experiments. In the first of the three analyses, MMR children on medication were compared to the non-medicated MMR children with respect to mean reaction time (RT), standard deviation (SD) and number of correct responses. No group differences were found. In the second of the three analyses, the MMR children on medication and the MMR children not taking medication were compared to the control group. No differences were found. In the third analysis the CBCL-TRF scores of the MMR children on medication were compared to those of the MMR children not taking medication. In every subscale no differences were found between the medicated and the non-medicated MMR group.

In sum, all the analyses showed that medication had no effect on the MMR group with externalizing disorders during the three experiments.

DISCUSSION

The present study evaluated attentional functions in children with MMR with externalizing disorders. To this purpose children were compared to a normal control group using a visual-scanning test, a covert shift of attention test and a divided-attention test.

A difference in test performance was found between the groups on the visual scanning test: the MMR group showed greater variability in response coupled with a higher error percentage than the control group. Although an interesting result, it is difficult to interpret since the test is a screening-instrument measuring a whole web of cognitive functions simultaneously (such as: impaired eye-movements, an impaired scanning system, problematic monitoring or directing of attention, or problematic sustained attention). Therefore, experiments 2 and 3 were implemented in the current study in order to measure more specific attentional functions: the second experiment focused on so-called covert shifting-of-attention (engagement/disengagement) and the third experiment was designed to measure the capacity to divide attention.

With respect to the second experiment, it was demonstrated that valid cues produced faster and more accurate responses than invalid cues, which allowed us to interpret the current findings in terms of cost and benefit of attentional preparation and shifting. The expectation was that the MMR group would demonstrate a greater performance decrement under the invalid cue condition compared to the normal control children. However, this was not the case with respect to mean RT. The clinical group actually outperformed the control group in the invalid condition. In addition, the clinical group did not make any more errors than the control group. Groups differed with respect to SD of RT. An additional analysis indicated that this effect was caused by the younger MMR children with externalizing disorders: i.e. older MMR children with externalizing disorders had SDs similar to their peers in the control groups. Therefore, covert attentional-shifting is intact in children with MMR with externalizing problems when they grow older. Experiment 3 showed that these children do not have a limited-attention capacity when compared to the normal group. Therefore, experiments 2 and 3 indicate that MMR with externalizing disorders is not associated with a basic-attention deficit. Consequently, one may argue that the poor performance demonstrated by this group in the visual-scanning test used in Experiment 1 cannot be explained by specific dysfunctional attentional abilities. However, this conclusion might be premature. It must be underlined that the visual scanning test was a self-paced test, whereas the other two tests were computer-paced. Barkley (1994) claims that the self-monitoring factor (self-paced vs. computer-paced) is crucial in children with an externalizing disorder coupled with an IQ level in the normal range. Hence, additional research is needed to investigate whether this claim also holds for MMR children with externalizing disorders.

With the challenging conclusion that MMR with externalizing disorders is not associated with a fundamental attention deficit, an important question emerges concerning the fit of the present findings with other cognitive research in the domain of MMR with externalizing disorders. To date, only a handful of studies have been carried out to evaluate cognitive functions in MMR children with externalizing disorders. In each of these studies MMR children with externalizing disorders were only compared to MMR children; normal control groups were excluded. Using a play observation procedure, Handen, McAuliffe, Janosky, Feldman, and Breaux (1998) reported that children aged between 6 and 12 years old with moderate mental retardation (MMR) and externalizing disorders (Conduct Disorder and ADHD) were more vocal and engaged in a significant greater number of toy changes than the MMR-only control group. In the same study, group differences were recorded during a restricted academic task demonstrating more off-task behaviour in the MMR group with externalizing disorders than in the MMR-only control group. Similar findings were reported when children were observed in a classroom setting (Handen, McAuliffe, Janosky, Feldman, & Breaux, 1994). The observational findings were explained by Handen and colleagues in terms of impulsiveness and lack of attention. Pearson, Yaffee, Loveland and Lewis (1996) reported that during a Continuous Performance Test children with externalizing disorders (ADHD) and low IQ responded nearly four times more often to non-targets (commission errors) than did a MMR group without ADHD. According to the authors, this finding is suggestive of poor impulse control and poor attention in the MR with ADHD group. Melnyk and Das (1992), using Posner's physical and name identity test showed that MMR children with ADHD symptoms had a limited attention capacity compared to MMR-only control groups.

In sum, the studies indicate that children with the dual diagnosis, MMR with externalizing disorders, are more impaired in their attentional functioning than MMR-only children. In contrast to the studies mentioned above, the current study compared MMR children with externalizing disorders to a normal control group, showing that basic-attention abilities are intact in the MMR group with externalizing disorders.

There are two factors involved that may explain the difference between our study and the previously mentioned studies: 1) the IQ level of the subjects in our experiment was about 20 points higher than in the samples studied by Pearson et al. and Handen et al., 2) different types of tests were used in the studies. We used mainly computer-paced tests, whereas the previously mentioned studies only used self-paced tests. It is interesting to note that our self-paced test was the only test that differentiated between the MMR children with externalizing disorders and their peers in the control group. Therefore the self-paced versus paced conditions factor in the field of MMR with externalizing disorders requires further research.

With respect to the fit between the current experimental findings and cognitive research on externalizing disorders without mental retardation, it can be said that the experimental outcome of experiment 2 is compatible with three studies that used the spatial cueing test in ADHD children with a normal intelligence level. Studies showed that such children have no problems re-engaging attention when the inter-stimulus-interval between the cue and the target is short (200 msec). Only when the inter-stimulus-interval increased (> 800 msec) did poor attentional re-engagement emerge (Swanson, Shea, McBurnett, Potkin, Fiore & Crinella, 1990; Tomporowsky & Tinsley, 1994). Note: the stimulus interval in the current study was random and varied between 130 and 520 ms.

The outcome of experiment 3, showing that the two groups were equally able to divide attention between simultaneously presented stimuli in the auditory and visual test conditions, was compatible with the outcome of cognitive research in the domain of externalizing disorders without mental retardation. For example, when using a dual task, Schachar and Logan (1990) showed that divided-attention capacity was unimpaired in children with an externalizing disorder and an IQ within the normal range. Van der Meere and colleagues, employing the Sternberg (1969) Attention Capacity Test, have also repeatedly demonstrated that ADHD without mental retardation is not associated with a divided-attention deficit (for a review see Van der Meere, 1996).

In sum, it seems that basic-attention abilities are intact in ADHD/CD children with an IQ level around 70. Given these findings, the question arises whether the tasks were measuring a ceiling effect. Kunert et al. (1997) demonstrated that there are strong developmental trends in all of the tasks. The performance of the younger children in his study was worse than that of the older children. It was expected that, because of the lower mental age of the MMR children with externalizing disorders, the performance of the MMR group would be worse. This was not the case.

This study reinforces the need for both a broad and a specialist approach to diagnosing children with a mental handicap. It shows that not all children with a mental handicap and ADHD have attentional problems, which means that treatment can be focused on other aspects of the problematic behaviour in the children.

Factors affecting the interpretation of the current study will now be discussed. These include: 1) the type of children who participated in the experiments, 2) the fact that about half of the institutionalized MMR children were on medication during testing, 3) the number of subjects who participated.

The purpose of the current study concerned the nature of the cognitive deficit in children with mild mental retardation and externalizing disorders. The MMR sample with externalizing disorders who participated is unlikely to be representative of children with ADHD and a low IQ score, given their inpatient status and the criteria of dysfunctional family and intractable disruptive behaviour required for admission. As a result, their drug treatment (pipamperon which is a neuroleptic drug) is atypical in the field of ADHD. In The Netherlands and Belgium, the drug is given to mentally retarded children with integration disabilities (Gunning, 1994). The drug is administered when all other medication has been ineffective. Therefore, the drug can be seen as a last-resort drug. The severity of the problematic behaviour in the children participating made it unethical to stop medication for the purposes of the experiments. Given the aim of the study, an important question arose concerning the extent to which pharmacology had contributed to the main finding of the study: MMR children with externalizing disorders have intact attentional abilities. A number of analyses were carried out in order to measure the effect of medication on RT performance. Based on such post hoc analyses, it seems plausible to conclude that medication did not confound the outcome of the current study.

It must be emphasized again that the aim of the study was to investigate cognitive abilities in a patient group, which required a controlling device to check for the possible effects of medication, in this case pipamperon. The aim was not to measure the clinical effectiveness of pipamperon because the range of dependent variables employed was obviously too limited to meet the requirements needed to achieve this. However, it remains a surprising finding that this compound did not interfere with the cognitive measures used in this investigation. At best, we could speculate that the MMR children on medication might perhaps have performed poorly had they not been on medication while participating in the tests. For the moment, however, it is more appropriate to conclude that the outcome with respect to medication calls for further research with the measurement of the beneficial effects of pipamperon in MMR children with externalizing disorders as the primary aim.

It may be argued that a model involving a small number of subjects, as was the case here, does not provide a ready interpretation of experimental effects. There are three points to be made regarding this issue. 1) in spite of the small numbers, all groups conformed to the predicted effects of the manipulative tasks. 2) the MMR group with externalizing disorders exhibited poor-inhibitory control in two different experimental paradigms. Hence, the strength of the present findings is not only based on statistical or group size, but also on replication. 3) Rosenthal and Gaito (1963) have indicated that given two experiments with the same level of significance, the experiment with the smaller sample size would produce the more convincing results.

We must concede that this study would have been greatly strengthened by a comparison with children with disruptive behaviour disorders of normal intelligence in addition to the comparison with normally developing children. However, it must be reiterated that the target group of this study was not only disruptive, but had many additional problems as well. Therefore, it was impossible to create a research design that would deal with all the variables present in the target group.

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REFERENCES

Akhtar, N., & Enns, J.T., (1989). Relations between covert orienting and filtering in the development of visual attention. *Journal of Experimental Child Psychology, 48,* 315-334.

Aman, M.G., & Fields, C.J. (1985). Pharmacological management. In N.N. Singh and K.M. Wilton (Eds.), *Mental retardation in New Zealand: provisions, services and research* (pp. 223-249). Christchurch, New Zealand: Whithcoulis Publishers.

Barkley, R.A. (1991). *Attention deficit hyperactivity disorder. A handbook for diagnosis and treatment*. The Guilford Press, New York.

Barkley, R.A. (1994). Impaired Delayed Responding, a Unified Theory of Attention-Deficit Hyperactivity Disorder. In Donald K. Routh (Ed.), *Disruptive behaviour disorders in children*. Plenum Press, New York.

Craft, S., Gourovitch, M.L., Dowton, S.B., Swanson, J.M., & Bonforte, S. (1992). Lateralized deficits in visual attention in males with developmental dopamine depletion. *Neuropsychologia, 30,* 341-351.

Demb, H.B. (1991). Use of Ritalin in the treatment of children with mental retardation. In L.L. Greenhill and B.O. Osman (Eds.), *Ritalin, Theory and patient management*. (pp. 155-171). Mary Ann Liebert, Inc. Publishers. New York.

Enns, J.T., & Brodeur, D.A. (1989). A developmental study of covert orienting to peripherical visual cues. *Journal of Experimental Child Psychology, 48,* 171-189.

Farmacotherapeutisch Kompas (1996). Ziekenfondsraad, Amstelveen.

Gadow, J.D. (1985). Prevalence and efficacy of stimulant drug use with mentally retarded children and youth. *Psychopharmacology Bulletin. Special feature: ADD-H and mental retardation, 21,* 291-303.

Gittelman, R. (1988). The assessment of hyperactivity; the DSM-III approach. In L.M. Bloomingdale and J.A. Sergeant (Eds.), *Attention Deficit Disorder, criteria, cognition, intervention* (pp. 9-28). Pergamon Press: Oxford.

Gunning, W.B. (1994). Keuzecriteria van psychofarmaca in de kinder- en jeugdpsychiatrie. *Acta Neuropsychiatrica, 6,* 36-42.

Handen, B.L., McAuliffe, S., Janosky, J., Feldman, H., & Breaux, A.M. (1994). Classroom behaviour and children with mental retardation: Comparison of children with and without ADHD. *Journal of Abnormal Child Psychology, 22,* 267-280.

Handen, B.L., McAuliffe, S., Janosky, J., Feldman, H., & Breaux, A.M. (1998). A playroom observation procedure to asses children with mental retardation and ADHD. *Journal of Abnormal Child Psychology, 26*(4), 269-277.

Jonkman, I., Licht, R., Bakker, D.J., & Van den Broek-Sandmann, T.M. (1992). Shifting of attention in subtyped dyslexic children: an event related potential study. *Developmental Neuropsychology, 8,* 243-259.

Kaye, D.B., & Ruskin, E.M. (1990). The Development of Attentional Control Mechanisms. In J.T. Enns (Ed.), *The development of attention, research and theory.* Elsevier: North Holland.

Kunert, H.J., Derichs, G., & Irle, E. (1996). Entwicklung von Aufmerksamkeitsfunktionen im Kindesalter: Ergebnisse einer vorläufigen Normierung der computergestützten Testbatterie zur Aufmerksamkeitsprüfung (TAP) in 9- bis 12 jährigen Kindern. *Zeitschrift für Neuropsychologie 7*(2), 92-113.

Melnyk, L., & Das, J.P. (1992). Measurement of Attention Deficit: Correspondence between Rating Scales and Tests of Sustained and Selective Attention. *American Journal on Mental Retardation, 96,* 599-606.

Pearson, D.A., Yaffee, L.S., Loveland, K.A., & Lewis, K.R. (1996). Comparison of Sustained and Selective Attention in Children who have Mental Retardation with and without Attention Deficit Hyperactivity Disorder. *American Journal on Mental Retardation, 100 (6),* 592-607.

Posner, M. (1980). Orienting of attention. *Quarterly Journal of Experimental Psychology,* 323-325.

Posner, M.I., & Peterson, S.E. (1990). The attention system of the human brain. *Annual Review of Neuroscience, 13,* 25-42.

Rosenthal, R., & Gaito, J. (1963). The interpretation of levels of significance by psychological researchers. *Journal of Psychology, 55*, 33-38.

Schachar, R., & Logan, G.D. (1990). Are hyperactive children deficient in attentional capacity? *Journal of Abnormal Child Psychology, 18*, 493-513.

Sternberg, S. (1969). Discovery of the processing stages: extensions of the Donder's method. In W.G. Kosters (Ed.), *Attention and performance, Vol. 2,* (pp. 276-315). Amsterdam: Noord Holland.

Swanson, J.M., Shea, C., McBurnett, K., Potkin, S.G., Fiore, C., & Crinella, F. (1990). Attention and hyperactivity. In J.T. Enns (Ed.), *The development of attention: research and theory* (pp. 383-403.). North Holland: Elsevier Science Publishers BV.

Taylor, E. (1980). Brain damage: evidence from measures of neurological function in children with psychiatric disorder. In E.F. Purcell (Ed.), *Psychopathology of children and youth: a cross-cultural perspective* (pp. 97-113). New York: Josiah Macy, Jr. Foundation.

Tomporowski, P.D., & Tinsley, V. (1994). Effects of target probability and memory demands on the vigilance of adults with and without mental retardation. *American Journal on Mental Retardation, 98*(6), 688-703.

Van der Meere, J.J. (1996). The role of attention in hyperactivity disorders. In S. Sandberg (Ed.), *Monographs on child and adolescent psychiatry: hyperactivity disorders*. (pp. 109-146). Cambridge University Press.

Van Putten, R.G. (1990). Dipiperon, een buitenbeentje onder de neuroleptica. *Janssen Medisch-Wetenschappelijk Nieuws, 5*, 55-60.

Zimmermann, P., & Fimm, B. (1997). *Testbatterij voor aandachtsprestaties (TAP). Versie 1.02. Handboek, deel 2 (statistiek)*. Würselen: Psytest.

Zimmermann, P., & Fimm, B. (1996). *Testbatterij voor aandachtsprestaties (TAP). Versie 1.02. Handboek, deel 1*. Würselen: Psytest.